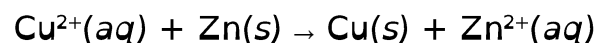


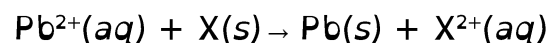
## ANSWERS: Displacement

1) In Beaker 1, the blue solution will turn very pale or even colourless. There will be a pink-brown copper precipitate on the rod or on the bottom of the beaker. In Beaker 2, there will be no change. This is a displacement reaction. Zinc is above copper in the activity series, it will have displaced Cu out of the copper sulfate solution by losing electrons that are gained by  $\text{Cu}^{2+}$ , which is why there is a pink-brown copper / Cu precipitate. Copper ions,  $\text{Cu}^{2+}$ , give the solution its blue colour, and since they are being removed from the solution, the colour of the solution fades to colourless ( $\text{Zn}^{2+}$  ions are colourless).

There is no reaction in the second beaker because Zn is below Mg on the activity series so is unable to displace Mg out of the solution.



Any metal that is above Pb on the activity series is suitable because all metals above it on the activity series will displace lead out of solution.

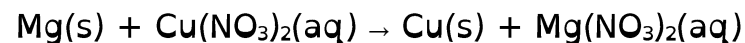
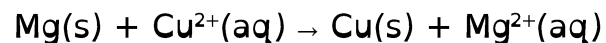


2)

	Zn	Mg	Cu	Pb
$\text{Cu}(\text{NO}_3)_2$	✓	✓	no	✓
$\text{Pb}(\text{NO}_3)_2$	✓	✓	no	no

For example: In the reaction between magnesium metal and copper nitrate solution, the grey magnesium metal would (slowly) disappear and an orange / brown deposit / solid / precipitate of copper would form. The blue copper nitrate solution's colour would fade to colourless as magnesium ions displace the blue copper ions from the solution resulting in a magnesium nitrate solution. Since the magnesium has displaced the copper ions (copper in solution) from the solution, this is a displacement reaction (redox).

Balanced equation: Either



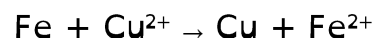
Zinc, copper and lead do not react with magnesium nitrate because magnesium is higher on the activity series, so is more reactive than the other metals. Therefore none of zinc, copper, or lead can displace magnesium ions from solution, so no reaction will occur.

3) The blue  $\text{CuSO}_4$  solution decolourises / fades overnight and the iron nail has a thick pink / brown / orange deposit on it. The iron nail slowly dissolves.

There is no reaction between the copper nail and  $\text{FeSO}_4$ .

*(Candidates may recognise that  $\text{Fe}^{2+}$  reacts to form  $\text{Fe}^{3+}$  overnight, so the appearance of the solution changes from pale green to yellow / orange. They must also recognise that the copper nail does not react.)*

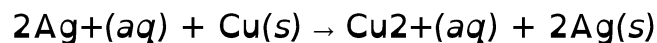
This is a displacement (oxidation-reduction) reaction as Fe is able to displace the copper ions from solution, as iron is higher than copper in the activity series / iron is more reactive than copper.



Tin goes between iron and lead in the activity series. Iron is more reactive because it displaces both tin ions,  $\text{Sn}^{2+}$ , and lead ions,  $\text{Pb}^{2+}$ , from solution. Lead is less reactive than tin as it will not displace  $\text{Fe}^{2+}$  or  $\text{Sn}^{2+}$ . Tin sits in the middle because it will displace lead ions from solution, but cannot displace iron ions.

4) A grey / black / silver deposit slowly forms on the copper wire. This is the formation of silver (Ag) as silver ions are displaced out of solution. The colourless solution will slowly turn blue and copper wire dissolves / decreases in mass. This is because  $\text{Cu}^{2+}$  ions are moving into solution. The displacement reaction occurs because copper is more reactive than silver. (Copper is higher than silver on the metals Activity Series.) The copper atoms will form copper ions in the solution, and the silver ions in the solution will form silver metal on the surface of the wire.

Equations:



5) Physical changes:

A pink deposit slowly forms on the iron nail when placed in the blue copper sulfate solution. Over a long period of time the blue solution decolourises.

Chemicals involve in changes:

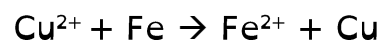
The pink deposit is copper metal.

The blue solution fades because blue copper ions are being removed from the solution.

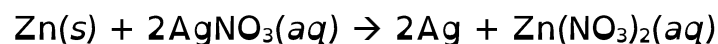
Displacement reaction:

The displacement reaction occurs because iron is more reactive than copper. The iron atoms will form iron ions in the solution and the copper ions in the solution will form copper metal on the surface of the nail.

Equations:



6)



7) i) This is a displacement reaction

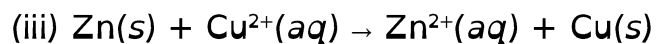
ii) According to the reactivity series, magnesium is more reactive than iron. This means magnesium will replace the iron (II) ions in solution, causing the green solution to fade, since magnesium sulfate solution is colourless. The iron (II) ions will form iron metal, this is the 'new dark grey solid' that forms on the bottom of the beaker.



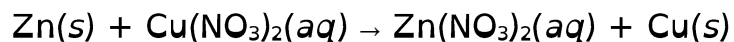
8) aluminium + silver nitrate → silver + aluminium nitrate

9) (i) pink or brown or black coating on zinc

(ii) blue colour of solution fades or zinc foil disappears pink or brown deposit on zinc can be accepted if not used in part (i) Electrons have been transferred. Zinc has provided electrons to the copper ions (blue solution) so they have been displaced out of solution. Zinc ions are now in solution and they are colourless. Pink-brown copper metal (solid) has been deposited.

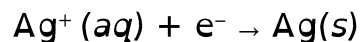
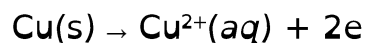


OR

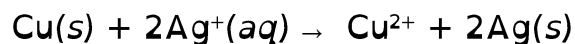


10) Blue colour is due to copper ions/ $\text{Cu}^{2+}$ . Grey solid is silver metal / Ag metal. Cu is oxidised because it loses electrons / increases its valency.

$\text{Ag}^+$  is reduced because it gains electrons / decreases its valency.



OR



OR

